4. Other Methods for Calculating Interaction

The most useful tools for accurately determing the interaction of
units in a system are the Monte Carlo computer programs which
determine the overall system reactivity. The GEM 4 and KENO codes
have been extensively correlated with various experiments and have,
in general, been found to estimate the reactivity of a system con-
servatively, although for some solution array experiments the Monte
Carlo calculations appear to be nonconservative. Therefore, the
user should be well versed in techniques of using these codes before
applying them to actual problems.

Thomas(1,2) has used Monte Carlo calculations extensively to study
the effects of various parameters on the reactivity of arrays. Such
effects as fissile unit size, shape, composition and location in a
storage cell; the cell size, shape and interspersed moderation; the
array size and shape; array reflector material, thickness and loca-
tion have been studied. The critical array size for various uranium
cylinders, with respect to array spacing as shown in Figure V.D.1-8,
is an example of Thomas' calculations.

Figures V.D.1-6 and 7(3) were made from GEM 4 and KENO calculations
for plutonium metal spheres in large arrays, the first figure show-
ing the effects of unit size, array reflector, interspersed modera-
tion, and k_{eff} of array size. The calculations in the latter figure
show the critical array size of plutonium metal spheres of 2, 3 and
4 Kg reflected by 12 inches of concrete. The calculated arrays
have a k_{eff} of 0.98 $\pm$ .02.

The study by Carter(4) on the safe storage of underwater arrays is
another example of the use of Monte Carlo calculations. See Section
V.D.2

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[1]J. T. Thomas, Uranium Metal Criticality, Monte Carlo Calculations
 and Nuclear Criticality Safety, Y-CDC-7, Union Carbide Corporation
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[2]J. T. Thomas, The Criticality of Cubic Arrays of Fissile Materials,
 Y-CDC-10, Union Carbide, Corporation Nuclear Division, (to be
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[3]K. R. Ridgway, Calculated Critical Arrays of Fissile Materials,
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[4]R. D. Carter, Safe Fissile Material Spacing in Water, ARH-SA-77,
 Atlantic Richfield Hanford Company, 1970.